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PRESIDENT'S MESSAGE

It seems to me that almost every president's letter I have written contains some comment on the development of Arboretum lease arrangements between the City and the University. This effort has been one series of high points and low, of concern and optimism. When the matter seems just about settled, another problem arises.

The matter of the Arboretum was discussed at the January 11 Board of Regents meeting. George Powell, one of the Board members, commented that he felt the City and the University are of like mind in most respects as to the lease agreement, and with re-wording in some problem areas, it could be acceptable to both parties.

However, as predicted, another problem has come up—that of a lawsuit being brought by the Arboretum Coalition against the University administration, the Board of Regents, the City Administration, Park Board, Park Department, and others. The purpose of the suit is to prohibit signing of a lease. Added to this is an initiative petition being circulated by the same people, which I am afraid confuses the general public regarding the University's intentions in the Arboretum and its relationship with the City.

Despite all this, the staff at the Arboretum under the direction of Joe Witt must be commended for having kept up their efforts at providing the best Arboretum facility that money and time will allow. Many others with less dedication would have long since given up in desperation. This is not just business as usual, for no one could be more concerned than they are for the Arboretum's future and the manner in which this problem is to be resolved.

I would also like to commend the Foundation membership which continues to work on supportive activities, such as the plant sale under the direction of Marge Clausing, and the *Bulletin* under the editorship of Doris Butler. It will take concerted effort in all the Foundation's activities during these unsettling times to continue our support and to demonstrate public interest in and the need for a quality Arboretum for Seattle—located at Washington Park under the direction of the University of Washington.

THE ARBORETUM BULLETIN

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THE UNIVERSITY OF WASHINGTON
Arboretum bulletin

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With this issue the ARBORETUM BULLETIN begins Volume XXXVII, No. 1 and changes its sequence to Winter, Spring, Summer and Fall of each calendar year. For the information of cataloguers, Issue No. 4 of Volume XXXVI, has not yet been published. It will be a nine-year cumulative index and is presently being prepared. It will be issued soon.

COVER PHOTO:
Chinese elm tree (*Ulmus parvifolia*) at Botanic Garden, Bath. Trunk 18" diameter. *Prunus serrulata* 'Miyako' in distance. *Photo:* B. O. Mulligan.

Seeds and Fruits and their Dispersal Strategies*

B. J. D. MEEUSE

Fruits of *Artocarpus* sp. (jackfruit) attached to main trunk—Caulicarpy; (dispersal by bats?) *Photo:* Dr. E. Anderson, Whitman College, Walla Walla, Wa.

Dispersal by mammals (mammaliochory).

This phenomenon, especially pronounced in the tropics, shows many similarities with ornithochory; indeed, many fruits are eaten by both birds and mammals. A special case, with fascinating features, is the dispersal by bats *(chiropterochory)*. Fruit-bats are nocturnal and color-blind, and in contrast to other bats their radar-sense seems to be poorly developed so that they have great trouble flying through dense foliage. However, they have a keen sense of smell. The odors they appear to prefer are somewhat similar to their own smell, musty and a bit sour or rancid rather than fragrant as a flower. The famous flying foxes *(Pteropus)* which have, on occasion, inflicted heavy damage in apple orchards in Queensland, can transport large fruits such as mangoes, but most other fruit-eating bats stick to smaller ones which they transport to a suitable eating place over small distances (a few hundred yards at best). Usually, they crave only the juice; after intense chewing of the fruit, the remnants (including the seeds) are spat out or dropped. On the basis of these bat-characteristics, it is easy to predict the "syndrome" of bat-dispersed plants. The most striking thing is that their diaspores are blatantly exposed outside the foliage; mango fruits, *e.g.*, dangle down from almost horizontal branches on long, slender stalks *(flagellicarpy)*, while the fruits of many figs, soursop, sapodilla, jackfruit, etc. are placed on the trunk or the main limbs of the tree (caulicarpy). In still other cases the tree is pagoda-shaped, which again results in excellent accessibility. Of course, flagellicarpy and caulicarpy alone are not enough to decide that there is bat-dispersal; in some cases, the flowers that preceded the fruits were *pollinated* by bats, while dispersal is taken care of by other

*This is the final part of Dr. Meeuse's two-part article. Except as noted, all photographs are courtesy of Sigurd Olsen.

Fig. 2. Fruit of *Xanthium* (cocklebur), a hitch-hiker. Clings to the fur of sheep, rabbits, etc. and is dispersed in this fashion.

means. Other features of the "bat-syndrome" are: fruits drab in color, sometimes off-white; frequently large, with a musty, somewhat rancid odor; juicy and soft, sometimes with large seeds (mango!). In contrast to the colorful and fresh-smelling table fruits of temperate regions, which are mostly derived from bird-fruits, the tropical ones are predominantly drab and large, with a quainter odor—they were "meant" for bats! Indeed, it often takes a while before the palate and the nose of Europeans newly arrived in the tropics are adapted to the strange flavor of mangoes, guavas, sapodillas and *Artocarpus*-species!

In Java, the omnivorous civet-cat *Paradoxurus hermaphroditus*, the luwak—which can climb trees—consumes many kinds of fruit. It is partial to those of coffee, but picks only the choicest ones. Since the luwak has the habit of defecating regularly in the same open spots (*e.g.*, on paths), it is not difficult for interested humans to collect the hard coffee-"beans" that have passed through the animal. Carefully cleaned and roasted, they yield coffee of the highest quality ("koppi luwak"). Another interesting case is that of the South African aardvark and the subterranean, large and juicy fruits of a wild cucumber, *Cucumia humifructus*. Practically always, the plant is found near the tunnels of the aardvark. The animal eats the fruit for its water, then carefully buries the seeds *with its own dung*. This can only be seen as a primitive case of symbiosis; without the fertilizer, the seeds do not germinate well.

Epizoochory is much more pronounced in mammals with their furry skins than it is in birds. Spiny, burr-like, hitch-hiking fruits have been developed by many families, *e.g.*, by the composites (burdock, *Arctium*; cocklebur, *Xanthium*, Fig. 2), the legumes (*Medicago*-species), the nightshades *(Solanum rostratum)*, the umbellifers (wild carrot, *Daucus*), and the grasses *(Tragus, Spartina)*. As could be expected, such fruits usually occur on plant species found in the underbrush or clearings (roadsides!) where contact with small furry mammals is likely—not on trees. In a special class are the "trample-burrs", such as those of mule-grab (*Martynia*, Fig. 3) and grapple plant (*Harpagophytum*, Fig. 4). Produced on

Fig. 3. Fruit (endocarp) of *Martynia*. Lodges in hooves of big grazing animals.

Fig. 4. Fruit of *Harpagophytum* (grapple-plant). Dispersed by grazing animals. Like *Martynia*, a "trample-burr."

Fig. 5. Seed of bleeding heart with elaiosome. Dispersal by ants.

the ground in open, sometimes desert-like country, they are dispersed by big grazing mammals, in whose hooves or fetlocks they become lodged.

Dispersal by ants (myrmecochory).

Certain amber-fossils from the Upper-Cretaceous make it clear that the social habit in ants (with all its implications of communal food-gathering, care of the young, etc.) is at least one hundred million years old—ample time for the ants to develop the manifold relations with plants which we can observe today. Especially in temperate regions, many plants produce small seeds with a fleshy, usually white, appendage, full of fat or other nutritious material: the so-called *elaiosome* or fat-body (Fig. 5). Ants, craving the food-bodies, collect such seeds and transport them to their nests, but many are dropped by the wayside. Ants can thus become an important factor in the dispersal of such plants. In somewhat neglected gardens one can easily observe that the seedlings of violets, primroses, bleeding hearts, cyclamens, hepaticas, snowdrops, lungworts, *Helleborus*, epimediums and trilliums are not distributed in random fashion, but are arranged in meandering lines, corresponding with the paths habitually followed by the ants. In Europe, *Corydalis*-plants are sometimes found growing high up on the walls of ruins, in sites which the seeds from which they sprang would never have reached without the aid of ants. Important though the possession of elaiosomes is, this feature alone is of course not sufficient to gurantee a plant reproductive success: if in a given locality ants and ripe seeds were not present at the same time, or if the insects could not reach the seeds, elaiosomes would be senseless. In reality, myrmecochorous plants display a whole array of adaptive features. With very few exceptions (such as tree-poppy, *Dendromecon*, a plant of the dry California chaparral) they are lowly herbs found in the woodlands of temperate regions where ants abound; violets are an excellent example. Most of them flower in the spring, so that the elaiosomes do not have to compete with other food sources for ants such as dead insects, which become abundant later in the year. A number of very "sophisticated" features guarantee the ants access to the seeds. For example, flower stalks which at the time of pollination were quite erect begin to bend earthward immediately afterwards, or they shorten dramatically by coiling, as charmingly demonstrated by *Cyclamen*. In many cases the fruit capsule opens on the side facing the soil. The ripe seeds detach themselves at the slightest touch, a process in which the elaiosomes sometimes assist by exerting pressure on the surrounding tissues. In other cases, *e.g.*, in Scotch broom, the seeds are scattered on the ground by being ejected from the fruit with explosive force.

As to the origin of myrmecochory, there can be no doubt that there are connections with ornitochory and an attractive sarcotesta. In a few cases *(Puschkinia, Ornithogalum)* we do indeed find that a complete, continuous sarcotesta plays the role of elaiosome. More often, the seed has local appendages. Whether these are always derivatives of an original sarcotesta is not really relevant; the important thing is that they are *functionally* comparable to it. A very instructive situation is found in the Euphorbiaceae, a group whose representatives in temperate regions (usually herbs!) have small seeds with elaiosomes, dispersed by ants. In the tropics, Euphorbiaceae are often shrubs or trees, such as the rubber tree, *Hevea brasiliensis*; their large seeds often have appendages that are so vividly colored that dispersal by birds, with their strong preference especially for reds and

oranges, seems very likely. A similar situation obtains in the Polygalaceae, a family which in temperate regions has representatives with myrmecochory. The tropical species *Polygala venenosa, P. arillata* and *P. pulchra*, on the other hand, have large seeds with a scarlet appendage, dispersed by birds. Within the genus *Trillium*, one finds myrmecochory as well as ornithochory.

Dispersal by the wind (anemochory).

Making certain assumptions about average wind velocity and turbulence, and knowing the characteristics (size, shape, weight) of the diaspores of various species, a "botanical engineer" can calculate the average limits of dispersal, *i.e.*, the distance which 1/100 of the diaspores can reach from the point where they were set free. For puff ball spores one thus finds 470,000 kilometers (!) or about 300,000 miles, for dandelion "seeds" *(Taraxacum officinale)* six miles, for pine seeds *(Pinus sylvestris)* 0.3 miles. It has been possible to test and confirm such figures in newly drained open polders in the Netherlands; *e.g.*, the dispersal limit reached there by *Aster tripolium* was three miles. Under storm conditions the figures are, of course, much higher; verified data show that poplar seeds then can cover twenty miles, and the diaspores of a ragwort, *Senecio congestus* (comparable to those of dandelion) 125 miles. Seeds which in smallness compare with spores are found especially in plant families that have many parasitic and saprophytic representatives (as could be expected); also in the orchids, which live in symbiosis with fungi (Fig. 6). A single "pod" of the vanilla orchid may contain a million seeds, and a broomrape seed may weigh as little as 0.001mg. However, if a few isolated diaspores travel very, very far, they

Fig. 6. Orchid seed (*Corallorhiza*) magnified 133x.

may "overshoot the mark"; *e.g.*, wild orchids which sometimes develop in Florida from seeds blown in from the West Indies do not reproduce, due to lack of suitable pollinators. Bigger seeds (and fruits) adapted to wind dispersal show all sorts of devices in the form

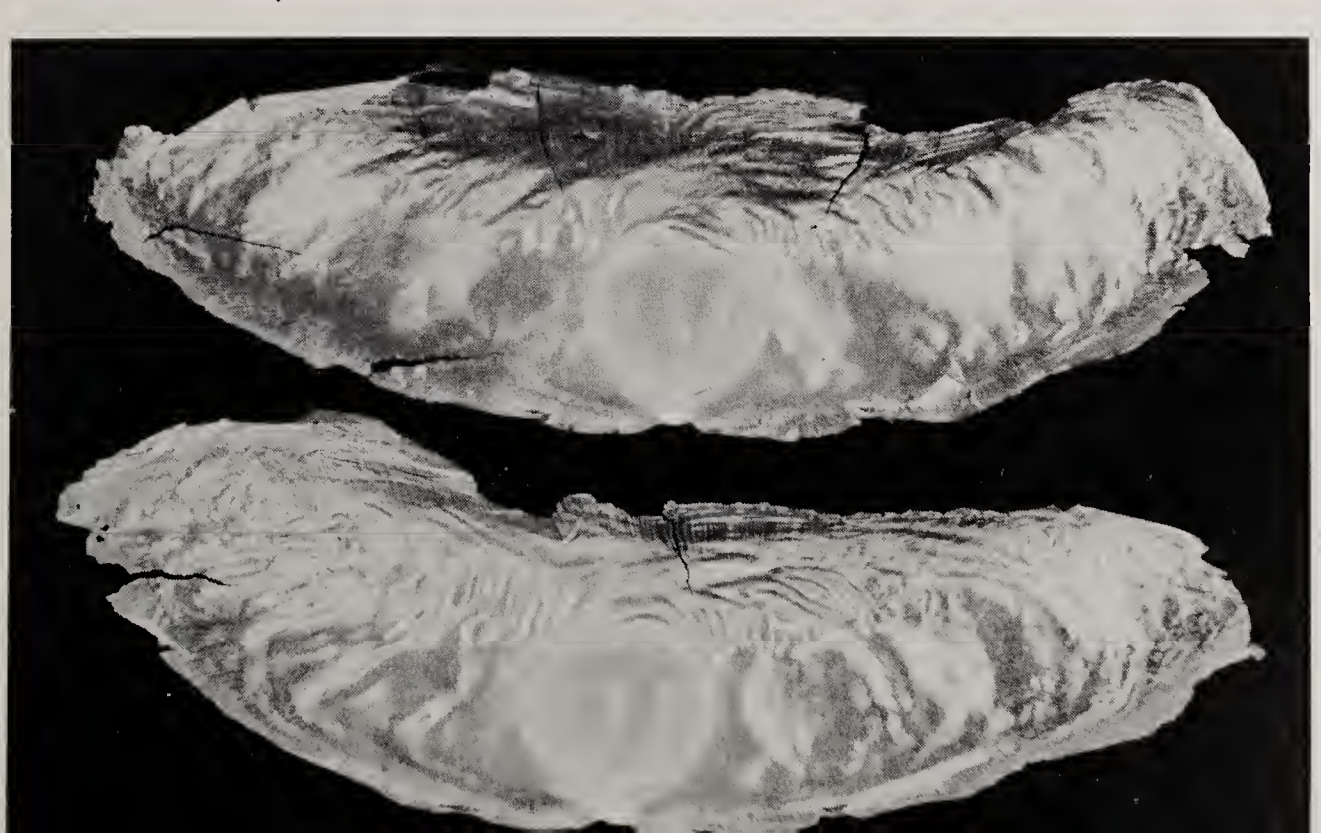

Fig. 7. Winged seeds of *Macrozanonia*; tropical jungles; wind dispersal.

Fig. 8. "Seeds" of *Tragopogon.*

Fig. 9. Winged fruit of elm (Ulmus).

of wings, plumes, down, hairs, etc. to keep them aloft (Fig. 7, 8, 9). Some thin-walled fruits are balloon-shaped and act as rollers. In the case of tumble weeds such as *Salsola kali* or Russian thistle in our Pacific Northwest, whole plants roll across the plains, scattering their seeds. In Indonesia and Australia, the round infructescences of the grass *Spinifex* are called "wind-balls". The so-called censer-mechanism of poppies *(Papaver)* deserves special mention. The fruit capsules (Fig. 10) are here placed on long, slender stems which sway back and forth and rotate in the wind, broadcasting the seeds, *which emerge from pores near the top*, over a surprising distance (up to fifteen meters).

Dispersal by water (hydrochory).

In some plants, the energy of falling raindrops that hit the fruit activates a lever mechanism which helps to throw the seeds out. In *Thlaspi, e. g.*, (Fig. 11), a crucifer whose fruits are very similar to those of the well-known dollar-plant *(Lunaria),* throws of almost a yard

Fig. 10. Fruit capsule of poppy (*Papaver*). Censer-mechanism for dispersal of seeds.

Fig. 11. Fruit of *Thalspi*, a "rain-ballist".

have been observed. More often we see that hydrochorous plants have diaspores that float on water. Yellow flag *(Iris pseudacorus),* a swamp plant, has disk-shaped seeds (Fig. 12) entirely different from those of *Iris foetidissima* (ARBORETUM BULLETIN, Fall, 1973, p. 16); they are water-repellent and float like corks. A number of temperate shore plants are dispersed by the sea; the most famous among these are species of *Cakile* (sea rocket). Specimens of *C. edentula* were the first higher plants to develop and to bloom on the virgin beaches of the new volcanic island Surtsey, near Iceland. The hard seeds of the tropical plants *Caesalpinia bonduc* and *C. bonducella* (Fig. 13), looking exactly like grey pebbles can be found on beaches and can float on sea water for years without losing their viability. Not surprisingly, these plants have an almost pan-tropical distribution. Coconuts also are dispersed by sea currents. The thick fibrous layer of the giant fruits keeps them afloat; once they have been beached, it soaks up rainwater, while in addition the coconut "milk" helps the seedling in establishing itself on a shore without much fresh water.

Dispersal by the plant itself (Autochory).

Self-dispersal can be achieved in all sorts of ways. A good example of an active ballist (from *ballo*—I throw) is Scotch broom. When the seed pods dry out in the summer, their two halves develop a strong tendency to warp in opposite directions; when finally

Fig. 12. Fruit and seeds of *Iris pseudacorus* (yellow flag iris); disk-shaped seeds (water-repellant) float on water.

this tension becomes unbearable, the pods "explode": *i.e.,* the valves separate with a popping sound, scattering the seeds (we have already seen that ants take care of the further dispersal of these). In *Bauhinia purpurea*, a small tropical tree belonging to the same family as Scotch broom, the seeds may cover a distance of fifteen meters. A similar mechanism operates in the sandbox tree, *Hura crepitans*, and the rubber tree, *Hevea*, both Euphorbiaceae. In other cases (jewel weed or

Fig. 13. Half-fruit of Caesal*pina bondue* with pebble-like seeds which float on sea water. Ocean-dispersed.

balsam, *Impatiens*), it is tension in the *living* fruit wall that causes the seeds to be ejected. Perhaps many weeds, such as *Oxalis* and *Polygonum* species, owe their success to the possession of explosive mechanisms. The famous squirting cucumber *Ecballium elaterium*, in which the sticky fruit pulp with the seeds is ejected *in toto* by pressure, requires the cooperation of animals (or man) that touch the base of the fruit. This is a borderline case of autochory, since the seeds presumably hit the "triggering" animal and are carried away on its body. The same may be true for *Arceuthobium*, the dwarf mistletoe of our Pacific Northwest, where the sticky kernels are liberated explosively from the fruits.

Non-dispersal (Atelechory and geocarpy).

One can legitimately ask whether it is always a good strategy for a plant to indulge in dispersal. The mere fact that a given plant individual reaches maturity and produces seeds indicates that the site where it grew up was a favorable one. In inhospitable environments such as deserts, good spots are few and far between, and the offspring of such a plant might have a better chance if it stayed close to home (*atelechory*, from *a* = not and *tele* - far) than if it strayed far. An interesting way to ensure atelechory is through *geocarpy,* the burying of fruits in the immediate vicinity of the mother plant. The best-known example of this phenomenon is found in the peanut, *Arachis hypogaea*, where the non-dehiscent fruit-pods remain attached to the plant. An additional advantage of geocarpy *may* be that it provides protection against seed-eating bruchid beetles and weevils.

Species of stork's bill *(Erodium*, related to *Geranium)* have self-burying "seeds" (actually mericarps, natural segments of a fruit that splits apart). In the dry state, the long and sharp appendage on each "seed" is coiled up (Fig. 14). Moistening by rain water causes uneven swelling and straightening out of the coil, with the result that the "seed" slowly propels itself into the soil with a corkscrew action. Stiff hairs on the coil, acting as barbs, prevent re-emergence of the buried "seed" upon the return of drier conditions. Since under natural conditions there is a daily cycle

Fig. 14. "Seed" (actually mericarp) of *Erodium gruinum*; interesting self-burial mechanism.

in soil humidity, a modest further penetration may occur on subsequent days until the "seed" finally comes to rest at a depth which is optimal for germination. *Cercocarpus*, a North American genus of trees in the rose family, has fruits that behave in very much the same fashion; however, since the hairs on the coil are more numerous and less spine-like than they are in *Erodium*, wind dispersal (over a limited distance) precedes burial.

Epilogue.

One can legitimately ask how close the flowering plants have come to exploiting *all* the possibilities for seed and fruit dispersal that are conceivable. Due to the usual limitations of time and space, we have not been able to cover more than a small fraction of the possibilities in this article. Still, we hope that we have succeeded in convincing the reader that plants have done a pretty exhaustive job. On the other hand, it may be wrong to use a past tense here, for the game is far from over! This is clearly demonstrated by the case of *Camelina sativa*, a roadside weed of the mustard family with special races that infest flax fields in eastern and northern Europe. The

(continued on p. 16)

Garden of Mr. Roy Elliott viewed from house. Alpine house on right. Birmingham suburb. *Photo:* B. O. Mulligan.

A "BUSMAN'S" HOLIDAY IN EUROPE*

BRIAN O. MULLIGAN

Part II — England and Wales

Leaving Edinburgh the morning of May 11 by a train which traversed the Scottish lowlands, we entered England at Carlisle, then proceeded south to the junction at Crewe in Cheshire where we waited more than an hour before catching another train to the city of Chester twenty-five minutes away. Here we spent the night before continuing into Wales the next day. It was easy to guess from the number of dairy cows which we saw from the train what one of the principal industries is in Cheshire. Ploughed fields were almost non-existent.

BODNANT

Next morning we picked up our reserved car, drove around the one-way traffic system and finally discovered the road westward for North Wales, a very popular route for vacationers and tourists but unfortunately most of it still only two lanes wide and frequently winding around curves. By noon, however, we reached our first destination, Conway, where one of King Edward I's castles still dominates the town and river mouth. After checking in at the appropriately named Castle hotel we drove on up the Conway river valley a few miles to Bodnant, residence of Lord and Lady Aberconway, who, to my mind, possess one of the greatest and most beautiful gardens in the British Isles. Bodnant excels for its situation on a shelf above the river overlooking the Welsh mountains to the west, for the excellence of landscape design around and below the large stone house, and for the variety, age and quality of the plants growing there. The present Lord Aberconway's grandfather began the garden in 1875 when some of the splendid conifers to be seen in the Dell at the bottom of the valley were planted (or added subsequently), including a remarkable specimen of the weeping form of the giant sequoia now about ninety feet tall, the California Santa Lucia fir *(Abies bracteata)* well

over one hundred feet high in this humid climate, and our native grand fir *(Abies grandis)* even taller at one hundred fifteen feet.

The unique series of terraces below the house were constructed by the second Lord Aberconway between 1905 and 1914. One of them includes a large pool of water lilies extending almost its whole length with a magnificent hundred year old *Cedrus atlantica* 'Glauca' at the north end. On another terrace a narrower canal reflects a charming old stone building built in 1730 as a garden house in the county of Gloucestershire and reconstructed at the present site.

The garden is so large and contains such a wealth of plants that a whole day could easily be spent in it, especially in the spring when the large collections of magnolias, camellias and above all, the rhododendrons, are in bloom. Many well known rhododendron hybrids were raised here, including *R*s. 'Cilipinense', 'Fabia' and 'Elizabeth', to mention only three of the best known. Of species, R. *augustinii* was about at its peak, with some excellent color forms; others included the rose-pink *R. orbiculare* down in the Dell, the yellow *R. campylocarpum* and old plants of *R. williamsianum* and various members of the *Lapponicum* and *Saluenense* series to be found in the Round Garden near the house. An outstanding shrub in bloom was *Staphylea holocarpa* var. *rosea* (native of central China introduced by E. H. Wilson in 1908) bearing graceful tassels of pale pink flowers on leafless branches. On the wall of one of the terraces masses of large old *Lewisia* plants shot forth sprays of rose-red to pink flowers, obviously happy in such a situation. Our only disappointment was that we were about ten days too early to see the famous arch of *Laburnum* x *watereri* in bloom—one of the most remarkable sights in this delightful garden, as the color photo on the cover of the well-illustrated booklet published by the National Trust attests.

BIRMINGHAM

Next morning we left Conway in drizzling rain and drove up the valley southwards until we joined the Holyhead-London road (A 5) at Bettwysy-coed, then headed southeast through Corwen and Chirk until after about seventy-five miles of winding two-lane roads we reached Shrewsbury in time for lunch. Our next destination, a suburb of the city of Birmingham, involved some twenty miles of a freeway (M 6), then negotiating some tortuous streets to find the home of Mr. Roy Elliott, Editor of the Alpine Garden Society's *QUARTERLY BULLETIN* and a very skilled cultivator of rock garden plants. Having met him and Mrs. Elliott previously both here and in England we were by no means strangers, but this was the first opportunity we had had to visit his famous gardens (he has two adjoining) and study both the plants as well as his methods of cultivation.

The two gardens, containing perhaps one quarter acre of land between them, are filled with an astonishing collection of the best in dwarf conifers: *e.g., Juniperus communis* 'Echiniformis', and *Pinus pumila* from Siberia, both probably the slowest growing of their respective races; the very smallest Douglas fir, *Pseudotsuga menziesii* 'Fletcheri'; as well as rock garden plants of every type, with shrubs such as *Prunus prostrata* from the eastern Mediterranean region; *Cytisus pygmaeus*, recently introduced from Turkey; dwarf and charming *Salix lanata* 'Stuartii'; herbaceous plants including species of *Podophyllum, Trillium* and *Uvularia*; with a splendid example of the Caucasian *Paeonia mlokosewitschii* displaying its pale yellow globes. *Fritillaria meleagris* was also very happy and flowering freely.

But the cream of the collections is to be found in the several unheated alpine houses, in the largest of which the plants are grown in beds some four feet high on either side of a central pathway. Such difficult alpine or rock plants as androsaces, saxifrages, *Asperula arcadiensis* from Grecian cliffs, the charming little lavender-blue *Viola albana*, and the extraordinary *Calceolaria darwinii* from Patagonia with a cluster of its chestnut brown, white striped flowers standing up three inches above the leaves, were to be seen and photographed here.

At the end of the garden a wall of tufa rock has been constructed and planted with other species requiring perfect drainage and

as much sun as possible; a heavy plastic screen overhead keeps off rain. Here we saw the rare *Primula forrestii*, native of western China; rosettes of the striking *Saxifraga longifolia* from the Pyrenees mountains; *Omphalodes luciliae* from Greece; and species of *Draba, Mertensia*, and other rarities.

Other protected corners and a long raised bed supported by a brick wall some three feet in height contain an extraordinary variety of the best kinds of rock garden plants which can be cultivated in this not very favorable part of England as far as the climate is concerned, besides being on the fringes of the second largest city in the country. The condition of the plants pays tribute to the loving care and skill of their owner.

WESTONBIRT ARBORETUM

From Birmingham we went south through Cheltenham, in Gloucestershire, up over the western edge of the Cotswold Hills, through Painswick where we stopped to see the remarkable avenue of yew trees in the churchyard, then on to Tetbury. Three miles south of this small town lies the internationally famous arboretum at Westonbirt, founded in 1829 by Mr. Robert S. Holford, succeeded in 1892 by his son, the late Sir George Holford, and now in the care of the Forestry Commission since 1956. The area is about one hundred sixteen acres, elevation four hundred feet, and the rainfall about thirty-five inches. The climate is somewhat comparable to that of the Puget Sound area except for the greater amount of summer sunshine around Seattle.

As may be imagined from the age of this estate, an ample number of old trees, both evergreen and deciduous, provide high shade and annual leaf fall to protect and nourish the smaller trees and shrubs which have been planted underneath them. Oaks, beeches, maples, Douglas firs, many kinds of pines, true firs and hemlocks are some of these. They supply an excellent background to the large collection of rhododendrons of which *R. augustinii* (sixteen feet in height), large, white flowered *R. arboreum, R. williamsianum* (almost six feet high), the first plants of the magnificent hybrid *R.* x *'Loderi'* and others were flowering. Westonbirt is especially noted for its collection of maples and we saw a number of Chinese and Japanese species in bloom, obtaining photographs of some of the more unusual *(Acer laxiflorum, A. tschonoskii*, and the lovely *A. pseudoplatanus* 'Brilliantissimum' with its apricot colored spring foliage). A familiar tree was our native *Cornus nuttallii*, about fifteen feet tall, in full bloom.

In some areas the ground beneath the oaks was carpeted with the English bluebell *(Scilla non-scripta)*, contrasting strongly with masses of dandelions. A different kind of contrast were the silver-white young leaves of the native English and European white-beam tree *(Sorbus aria)*, carefully set in front of the purple-leaved Norway maple (*Acer platanoides* 'Schwedleri'); adjacent to them were large trees of the Japanese Katsura tree *(Cercidiphyllum japonicum)*, the whole forming an unusually attractive grouping. This was in the area known as Silk Wood, which we visited next morning; most of this was planted by Sir George Holford in the early years of this century. One of the most outstanding trees at this season was a huge specimen of the native English wych elm *(Ulmus glabra)*, long past the flowering stage but with the leaves not yet fully unfolded. For any lover of or student of trees, Westonbirt should be the Mecca in Great Britain!

That night we spent with my former professor of plant pathology at the University of Bristol, Dr. Lawrence Ogilvie, at his home—an old farmhouse on the side of one of the many grassy limestone hills to be found in this agricultural part of England. No other building is to be seen from its windows, and yet it is only ten miles or so from the city of Bristol.

BATH AND OXFORD

Next morning, May 17, we turned eastwards, first to pay a short visit to the Botanic Garden of the city of Bath, a small enclave of perhaps four acres enclosed by an iron fence five feet high, within a large park full of fine old trees and grassy spaces. The Garden is only open at specified hours during the day, but is well worth a visit since it contains a wide variety of good quality plants suited to this climate, ranging from large trees (giant sequoia, incense cedar *(Calocedrus decur-*

rens), catalpas, *Cupressus glabra* nearly forty feet tall, and the rare Chinese *Populus lasiocarpa* almost seventy feet tall), through some excellent shrubs, especially Japanese maples, *Rosa* species, *Cornus, Berberis, Cotoneaster*, etc. to herbaceous and rock garden plants attractively arranged in a small rock garden. The whole forms an excellent example of what can be built up and maintained over a long period of years (more than half a century) by a comparatively small city and its Park Department.

After Bath our next place of horticultural interest was the Botanic Garden of the University of Oxford, one with which the Arboretum here has been exchanging seeds for many years. I had not seen it recently. We were fortunate to meet the Curator, Mr. Kenneth Burras, for a short time and to walk round part of it with him before he left for an appointment. This is the oldest botanical garden in the British Isles, having been founded in 1621 by the Earl of Danby, thus antedating that at Edinburgh (1670) by almost fifty years. The area is approximately five acres. The original stone wall surrounding the Garden, ten feet high or more, is still in excellent condition and supports or protects a great number of otherwise somewhat tender shrubs or climbing plants: *Mahonia lomariifolia* from southwest China, a plant which we find impossible to establish in the Arboretum in Seattle; the parrot's beak of New Zealand, *Clianthus puniceus*, which was actually flowering; and a golden leaved form of the true bay tree, *Laurus nobilis*. A notable and probably unique collection is that of variegated plants of as many kinds as possible, arranged according to the reason for their variegation, chiefly botanical chimaeras of differing origin. Four distinct species of *Iris* were represented among them. Other rectangular beds contain plants of various families, as is usual in University botanical gardens in Europe.

Just outside the old boundary wall, in a more recent extension of the Garden, are two charming and carefully planted small rock gardens, one on limestone, the other on tufa rock. Alpine poppies, saxifrages, sedums, phlox, penstemons, *Gypsophila* and *Daphne cneorum* were all here to be seen. Beyond them were collections of crab apples, *Berberis* and *Rosa* species, and at the extreme end of the area a small water garden appropriately planted with hostas, marsh marigolds (both single and double forms), moisture-loving irises and primulas. All in all, there is a great deal to be seen in this University Garden.

WISLEY

That same afternoon, May 18, we reached the Royal Horticultural Society's Garden at Wisley, located just off the London-Portsmouth road (A 3) between Cobham and Guildford, in the county of Surrey. The Garden, originally a private estate, was given to the Society in 1903 and is seventy years old under this jurisdiction. Nearly two hundred acres are now included. The soil is generally sandy, well drained and basically of poor quality, much improved however, by years of cultivation. The Director is Mr. C. D. Brickell.

Since the Garden covers every kind of horticulture and is divided into areas devoted to each of them, it is relatively easy for visitors to spend their time in one or two sections only, such as the large Rock Garden, or the rhododendron and azalea plantings on Battlestone Hill, or in summer to see the roses and annuals, or the extensive assortment of heathers in Seven Acres. Furthermore, since there is a restaurant in the grounds, one can arrive in the morning, spend time in certain sections, have lunch and then continue through others. A whole day can very easily and profitably be spent in this manner, given fine weather.

One of the first shrubs we noted on our arrival was an immense old specimen of *Ceanothus impressus* 'Puget blue' with its rich blue flowers, adorning the west wall of the brick and timber laboratory building. This form, of course, originated at the University of Washington Arboretum in 1945.* From there we wended our way to the rock garden, where the superintendent, Mr. W. K. Aslet, was directing a new planting by students, beside the pools at its foot. The rock garden, constructed in 1911 of red sandstone, covers at least half an acre on a north slope, and contains an immense variety of suitable small shrubs, alpine plants and bulbs to provide

color for as long a period as possible.

On the hillside above it is an unheated alpine house which during the spring months is filled with appropriate plants grown in clay containers and brought into the house at flowering time. Among plants noted were species of saxifrage, *Campanula, Lewisia, Gentiana verna*, auriculas and an *Iris* from western Asia. More of the latter were in bloom in a frame nearby, some pale yellow, some smoky blue.

Four days later we returned and walked up to Battlestone Hill, where the very extensive collection of Kurume azaleas from Japan was in full bloom, making a wonderful splash of brilliant colors. Adjoining these on the Hill many rhododendrons were also at their peak, including *R. fortunei*, several forms of the hybrid *R.* x 'Loderi', all twelve to fourteen feet in height and width; and *R.* 'Moonstone', raised at Wisley by the late Francis Hanger. *R.* 'Burma Road' (*R.* 'Tangerine' x *R.* 'Romany Chal') was conspicuous with its peach-colored flowers. Among the red-hued rhododendrons were *R*s. 'Grenadier' and 'Goldsworth Crimson', the latter about fifteen feet high.

Many other fine shrubs and small trees grow in this part of the Garden beneath the tall Scots pines which flourish here: *Magnolia sinensis* (flowering), various species of maples, mountain ashes *(Sorbus), Hamamelis mollis, Eucryphia* (to bloom in August), and *Mahonia lomariifolia* which we had seen at Oxford.

At the foot of this north slope a series of small terraces is constructed of blocks of peat, except for the lowest one which is of stone to act as a retaining wall. These contain a selection of plants which enjoy such conditions including various primulas, cassiopes, trilliums, dwarf rhododendrons, *Soldanella alpina* and hepaticas. There is provision for artificial watering in summer. It appears to be a most successful planting.

No matter at what time of the year one visits Wisley, something of interest and beauty is to be found. It is about an hour's drive from central London and is open to non-members of the Society every day except Sunday.

WINDSOR

Having the great advantage of staying with friends at Ascot about twenty-five miles west of London for six nights from May 18-23, enabled us to visit several places of special interest within a day's drive. One of the nearest and best of these is the Savill Garden and adjacent Valley Gardens in Windsor Great Park, both Crown property and maintained by Government funds. The former was planted between 1932 and 1939, with additions after the war (1950) in the form of a rose garden, herbaceous borders, a wall for more tender plants and raised beds for alpine plants. Total area is about twenty-five acres, much of which is both sheltered and partially shaded by large trees such as oaks and beeches. These provide excellent conditions for rhododendrons and azaleas, especially as the soil is largely of a sandy type; camellias and magnolias are also grown in great quantity and variety, and in fact, there is scarcely any shrub or small flowering or fruiting tree of quality which is not to be found somewhere in these Gardens. Much thought has also been given to the arrangement of the plantings, to provide conspicuous effects at different seasons of the year; for example, daffodils in the grass in the spring, *Primula* species and hybrids in wet places in May, the rhododendrons and azaleas already mentioned (the most extensive collection of *Rhododendron* species will be found in the Valley Garden), irises in June, followed by the roses, the herbaceous borders, hydrangeas, autumn leaf color and fruits in October, and finally the color of bare branches and stems in winter, especially that of the shrubby dogwoods and willows.

At the time of our visit the charming little foam flower, *Tiarella cordifolia*, which is used generously as a ground cover, was in bloom, as were many rhododenrons, species such as *R. yunnanense*, the splendid form of *R. wardii* with pure yellow flowers two and one-half inches wide, collected by the late George Sherriff in southeast Tibet, and a memorable group of *R. yakusimanum* growing under large old Austrian pines on the side of a hill and just coming to its peak. The hybrids of *R. cinnabarinum* such as 'Lady Rosebery'

(continued on page 23)

Gardens of En

Photos by B

Hostas and rhododendrons in Savill Gardens, Windsor.

Multi-trunked tree of wych
Westonbirt Arboretum.

Old flour mill (1837) at Bodnant. Pair of *Chamaecyparis lawsoniana* 'Kilmacurragh' 35′ tall in foreground.

Royal Horticultural Society Garden, Wisley,

and and Wales

an O. Mulligan

(*Ulmus glabra*) in Silkwood,

y. View over new pool to laboratory.

Group of *R. yakusimanum*; Valley Gardens, Windsor Great Park.

Gateway (16) at University Botanic Garden, Oxford. Tree of *Sorbus domestica* in distance (d.b.h. 27 ins.).

Arboretum Classes

The College of Forest Resources coordinates the educational activities of the Arboretum. To register for classes, registration blanks are provided in SPECTRUM. If you wish your name to be placed on the list to receive SPECTRUM, phone 543-2590 or write University of Washington (DW-20), 400 Lewis Hall, Seattle, Wa. 98195.

Pruning Ornamentals

Mr. Chico Narro, expert nurseryman, will demonstrate techniques for pruning trees and shrubs. Aboretum greenhouse; class limited to 30. Saturdays, March 23 and 30; 10-12 noon. 2 sessions, $5.

Spring Tours

Mr. Joseph A. Witt, Plant Curator of the Arboretum, will conduct tours of the Arboretum grounds in spring bloom, including Japanese cherries, rhododendrons and azaleas. Class limited to 25. Saturdays, April 6, 20, May 4, 18, June 1; 10-12 noon. Meet at Arboretum office. 5 sessions, $5.

Nature Photography

Mr. Donald Riecks, Director of UW Audio-Visual Services, will discuss techniques of photographing plant material under varying conditions of space, season and weather. Class limited to 15; meet at Arboretum office. Saturdays, April 20, 27, May 4, 18; 10-12 noon. 4 sessions, $10.

Insect Pests of Ornamentals

Ms. Sharon Collman, County Extension Agent, will teach this class on insect pests of the Puget Sound area. Topics covered will include insect identification, beneficial insects, garden ecology and control of common garden pests. Class limited to 25; 107 Winkenwerder, UW campus. Tuesdays, April 16, 23, 30, May 7; 7-9 p.m. 4 sessions, $10.

Summer Cuttings

Mr. Richard van Klaveren, Arboretum propagator, will teach seasonal techniques for propagating woody plants. Materials will be furnished. Arboretum greenhouse; class limited to 10. Saturdays, June 8 and 23; 9:30-12:30 p.m. 2 sessions, $10.

SEEDS *(continued from p. 8)*

original roadside type has small but compact seeds that can easily be separated from the much larger, flatter seeds of flax by winnowing. However, in the *Camelina* races found in flax fields natural selection has favored the creation of seeds that are not only larger, but also resemble flax seeds in their specific weight; therefore, the two kinds of seed can no longer be separated by winnowing-machines, and the *Camelina* seeds remain in the sample which the farmer sows. This is a case of true mimicry which arose before our own eyes—and clearly under our influence!—in a relatively short time-span. It demonstrates convincingly how much flux and "plasticity" there still is in this area. Things definitely are not petrified, and the dynamic nature-lover may find this a pleasing thought.

LITERATURE:

1. L. van der Pijl, "Principles of dispersal in higher plants", 2nd Ed. Springer-Verlag, Berlin/Heidelberg/New York, 1972.
2. H. N. Ridley, "The dispersal of plants throughout the world". Reeve, Ashford, 1930.
3. E. J. Salisbury, "The reproductive capacity of plants". Bell, London, 1942.

This is your Arboretum, kept alive by your support

We are pleased to welcome the following new members (November 1, 1973 through December 31, 1973):

Sustaining — T. L. Berger, Mrs. Fred Hazeltine, Mrs. Edward Moe. *Annual* — Elwood C. Avery, Sr.; Mrs. Stephen R. Black, Mrs. Weston T. Borden, Miss Norma Christopherson, Mrs. E. Storm Culbertson, Mrs. Robert C. Dunnell, Mr. and Mrs. Dalton Eash, Dr. and Mrs. Charles F. Gravenkamper, Mrs. Sue Hall, Dr. William H. Hatheway, Miss Verona Hofer, Mrs. George Johnson, Mrs. E. C. Kragh, Mrs. A. Kristofferson, Mrs. Robert C. Labonte, Dr. John C. Lind, Mrs. Morton Lloyd, J. E. Lockett, Ms. Virginia McDermott, Mr. and Mrs. Jonas Mynkantas, Mrs. Rod Newton, Mrs. Frank M. Oleson, Mrs. Grace Polito, Mrs. Melvin Potter, Mrs. Roy A. Robinson, Mrs. Harold A. Rogers, Mrs. R. E. Roman, Mrs. Cole M. Sherwood.

We are also grateful to the following members who have increased their dues to: *Sustaining* — Mrs. Leon Phillips, Mr. and Mrs. N. Stewart Rogers.

A REPORT on the HARDINESS OF EUCALYPTUS IN THE PACIFIC NORTHWEST

*DON RENFRO**

Of the hundreds of species and varieties of eucalypts that dominate the Australian landscape, there are perhaps about a dozen that are frost resistant in the Pacific Northwest. At least, that's the way it seems to Oregon teacher, plantsman, and landscape architect, Wallace "Mack" Ruff. Mack has spent more time studying the hardiness of eucalypts than any other single person in this country. Even then, the results of many years of his work may be lost within a few hours of unpredicted frost. Good naturedly, Mack takes it in his stride and cuts the frozen tree to the ground, knowing that within a few days the stump will regenerate and another tree will be on the way.

Lignotubers, food storage and regeneration

Most species of eucalypts develop an underground swelling known as a lignotuber, which is an organ of food storage and regeneration. The lignotuber is the key to the survival of the tree, and that is why Mack knows the tree may look dead or damaged, but is actually going to recover.

The origin of the lignotuber is in the axils of the dicotyledonous leaves, and may, in some cases, be found in the first two or three pairs of seedling leaves. It is usually visible to the naked eye and takes the form of a pair of small axillary protuberances which swell and fuse together into a more or less hemispherical mass. As the lignotuber develops, the mass grows down the stem and envelops the upper part of the root system. Increasing in size, it tends to bury itself in the soil until only a small portion, or none at all, can be seen. There it remains dormant until the upper portion of the tree is damaged or destroyed.

The lignotuber is of great significance to the plantsman because of its regenerative capacity. Mack has made interesting comparisons between the large lignotuber produced by the mallees (small shrubby desert species) and the lignotuber produced by the alpine species. In the former, he notes that the large lignotuber is produced very quickly, and buries itself deeply in the soil where it is protected. In the alpine species, however, the lignotuber is generally small and weak, and usually does not bury itself in the soil. It remains above ground where its only protection is other vegetation in the summer, and a blanket of snow or ice during the winter. It is from these observations that Mack has conducted much of his research with these amazing but complex trees.

The Beginning

Mack Ruff doesn't remember when he first became interested in Australian plants. It was probably while he was a graduate student in landscape architecture at the University of California, Berkeley, and prior to that while on a wartime tour of duty in the South Pacific. No doubt, this sparked the interest, but it was not until 1957 that he seriously began to test them in the Pacific Northwest.

The first planting was a small but select number of Tasmanian alpine and subalpine species introduced by Don Stryker of Langlois, Oregon. Stryker, a well-known rare plant collector, had received seed from the Forestry Department in Tasmania, and asked Mack to test the following species for hardiness in Eugene:

Spring 1957, Eugene

8 *Eucalyptus gunnii*
3 *Eucalyptus coccifera*
5 *Eucalyptus johnstonii (subcrenulata)*
2 *Eucalyptus gigantea (delegatensis)*
2 *Eucalyptus niphophila*

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*Mr. Renfro is an associate of Oregon landscape architect Wallace Ruff.

Of this group, *E. gigantea* was a non-lignotuber species. It was not able to regenerate quickly after a freeze, and by 1962, they were gone. *E. coccifera* also had difficulty during this period, and were subsequently lost. Its lignotuber response was not strong enough to sustain the winter. Later, Mack found that a deep mulch, 1-2 feet, of gravel, bark, or straw was ample insulation from the cold. And, ideally, he feels, "the seed should be collected from the coldest, most severe, climate the tree can tolerate."

1962 Sabbatical leave

A few months later, Mack was in the Snowy Mountains of Australia collecting his seed. He also collected seed and cutting from other plants in the area, so that he might have a better understanding about the natural plant communities. By the time his sabbatical was over, he had collected throughout Australia and Tasmania, and half the globe as well. Many of these original plants are still alive and well in Mack's greenhouses and back yard. (His biggest loss was during the recent week long freeze of December, 1972.)

Hardiness through 1969

For the next ten years, Mack continued to grow and plant eucalyptus. The original collection of five species grew to fifty, and then over a hundred. Another sabbatical in 1967–68 was spent going entirely around the world collecting plants. And prior to that, Don Vaughn, one of Mack's students at the University, made an excellent collection of alpine eucalypts while in Australia in 1963. From these collections over a hundred species have been planted and observed over a period of time. Freezes on January 12, 1963, December 17, 1965 and January 27, 1969, were periodic challenges to their hardiness. Many would survive one freeze and not another. Tender exotics, such as *E. ficifolia, E. calophylla, E. citriodora* and *E. macrocarpa*, were tested in sheltered areas. Of the alpine or subalpine species tested through the January 27, 1969 freeze (1°F.), the following observations were made:

Listed in order of hardiness in Eugene (temp. 1°F.):

E. niphophila — slight leaf burn
E. gunnii — slight leaf burn
E. perriniana — slight leaf burn
E. neglecta — slight leaf burn
E. parvifolia — slight leaf burn
E. vernicosa — varies in hardiness
E. johnstonii (syn. subcrenulata) — varies in hardiness, most regenerated.
E. urnigera — froze to the ground, regenerated
E. nova-anglica — froze to the ground, regenerated
E. pulverulenta — froze to the ground, regenerated
E. ovata — froze to the ground, regenerated
E. coccifera — froze to the ground, no regeneration
E. pauciflora — froze to the ground, no regeneration
E. gigantea — froze to the ground, no regeneration
E. dalyrmpleana — froze to the ground, no regeneration
E. rubida — froze to the ground, no regneration
E. alpina — froze to the ground, no regeneration
E. bicostata — froze to the ground, no regeneration

Of this group several are interesting to comment upon. *Eucalyptus rubida*, for example, is a species that was originally planted in the fall of 1966. As a young tree it was not able to survive the ensuing winter and froze to the ground. A thick mulch, however, protected the lignotuber. It coppiced and produced a 40 foot tree within two years. Unfortunately, it did not survive the 1969 freeze.

In its native habitat the species prefers the cool, mountain slopes of New South Wales where it lives with cold winds, fifty days of frost per year, some snow, and moderate but regular yearly rainfall. It is reasonable to expect it to be more resilient to Oregon's milder and shorter winter.

Another, *Eucalyptus vernicosa*, should also have responded more positively. The seed was collected from a hundred year old, very dwarfed tree. It was only 4 feet tall,

and it stood on a mountain peak. It is one of the hardiest trees in Tasmania. Germination is spotty and variable. A number of trees tested between January, 1962 and the 1972 freeze, varied in size from 3 to 30 feet in the ten year period. After the 1972 freeze, Mack feels "the very dwarfed ones are the hardiest." Lignotuber activity was exceptionally strong in these.

The December 7-12, 1972, Freeze

While the week-long December freeze was a disaster to greenhouse and other tender plants, most of Mack's older eucalypts faced it bravely. An exception is still *E. coccifera*, which should be hardy here but just can't make it.

All of Mack's trees froze to the ground. Unable to "ice" them during initial hours of descending temperatures, Mack thought he had lost all of them. And a long waiting period began. At the time of this writing, coppicing is vigorous and the dead wood has been removed. It is interesting to note that the lignotubers on these older trees produce hardier coppicing each succeeding freeze. Perhaps this would be the trees' mechanism in adapting to a radically different climate . . . one to which it is not yet genetically adjusted. Mack is particularly interested in the rate of growth at the end of this summer, as well as the hardiness of the new wood in the coming winter.

The following trees were frozen to the ground in the 1972 freeze: (In order of hardiness)

SPECIES	REGENERATION	RATE OF GROWTH	HEIGHT BEFORE DEC. 1972 FREEZE
E. gunnii	yes	rapid	35-45 feet
niphophila	yes	slow	25-30 feet
perriniana	yes	moderate	35-45 feet
neglecta	yes	moderate	30-35 feet
pulverulenta	yes	rapid	30-35 feet
vernicosa	yes	rapid	3 feet/10 years
urnigera	yes	rapid	30-40 feet
johnstonii	yes	rapid	15-20 feet
nova-anglica	yes	rapid	10-12 feet
coccifera	no	rapid	15-20 feet
pauciflora	yes	rapid	20-25 feet
ovata	yes	rapid	25-30 feet
dalrympleana	yes	rapid	10-12 feet

Temperatures: December, 1972, Eugene

December 7, -6°F., no snow cover
December 8, -12°F., snow cover, bright sun, thawing
December 9, -5°F., snow cover, bright sun, thawing
December 10, -7°F., snow cover, bright sun, thawing
December 11, -5°F., snow cover, bright sun, thawing

Conclusions:

In his optimism for continued success with the hardiness of the eucalypts, Mack has adopted a system of helping his trees and plants through a freeze. He passes it on to you.

1. If a known freeze is coming, turn the sprinkling systems on, watering the trees and plants. The ice insulates the plant, protecting it from chilling winds.
2. Never crowd the roots of the eucalypt or allow it to become root bound. The root system will not develop. Winds will blow the tree over.
3. Never stake a eucalypt, however great its seeming need. A staked tree will

not develop sufficient strength to stand by itself.

4. Always plant the smallest tree possible, especially if it is a young, vigorous seedling. A young tree will "catch up" to an older tree, and will be stronger over the years.
5. Mulch the tree as thickly as possible. Older trees can have as much as 2 feet of mulch around them. This insulates and protects the lignotuber.
6. Eucalyptus seed does not store food. A newly germinated seed must find food and moisture immediately or it will die.
7. Eucalypts are not competitive as seedlings, and weeds can easily choke them out. Clear and mulch a three foot circle around the tree for the first year.
8. Summer heat can actually be more harmful to some species than winter frosts. Mulching will keep the soil from drying out.

◆

EUCALYPTUS IN THE UNIVERSITY OF WASHINGTON ARBORETUM

9/7/73 — B. O. MULLIGAN

The following species are alive and in fair to good condition:

E. coccifera

(a) From Australian seeds, source unknown, 1968; plants 3.5 ft. tall.

(b) From seeds collected at Breona, Tasmania, 1970; plant 3 ft. tall. Earlier plantings grew to 20 ft. or more before being killed by cold.

E. gunnii

(a) From seeds collected on Mt. Arrowsmith, Tasmania, 1956. Reached 15-16 ft. by December 1970.
Killed to ground in 1964; now 10-20 feet tall.

(b) Seeds from Botanic Garden, Canberra, Australia, 1957.
One plant remains out of three; now 6 ft. tall. One other elsewhere sprouting at base.

E. niphophila

(a) From seeds from Botanic Garden, Adelaide, South Australia, 1958.
Tallest tree now 39 ft.; d.b.h. 10 inches.

(b) Plants received from U.S.D.A., 1956 (P.I. 220246).
One plant 25 ft. tall, one 9 ft. Three others killed to ground, sprouting from stumps.

E. parvifolia

(a) Seed from England, 1948.
One weak tree remains in nursery. Killed to ground 1968-69. Now 10 ft. tall. Was 15 ft. tall, December 1970.

(b) Raised from Australian seeds, 1968. Two planted July 1969.
One plant remains, cut to ground by cold; crown sprouting.

E. pauciflora

(a) Raised from seeds from Tasmania, 1963.
Killed to ground, 1968-69. Now about 40 inches tall.

(b) Plants received, raised from Australian seeds; planted May 1969. Grew to ten feet, then died to base, August 1973.

E. perriniana

(a) From seeds from Randwick, Austrailia, 1966; planted 1968.
One plant now 7.5 ft. tall, budded.

(b) Seedlings received from Cornell University, raised from Australian seeds, 1968.
One plant grew to 22 ft., but was killed by cold weather of 1971-72 and 1972-73.
Two smaller plants remain, planted June 1969, now 7-9 ft.

E. urnigera

Seedlings collected in mountains of Tasmania, 1969.
3 planted May 1970. One remains, now 15 ft. tall.
Other plantings of 1958 and 1968 from Australian seeds have all been killed by cold weather.

Species severely damaged by cold weather but alive at base

E. moorel
Seed from Canberra, Australia, 1965. Planted May 1966.
One plant only, was 9 ft. tall; killed to ground 1968-69 and subsequently.

E. nicholii
Seedlings from Cornell University raised from Australian seed, 1968.
Killed to ground 1971-72; again 1972-73. One plant crown sprouting.

E. nova-anglica
Seed from Victoria, Australia, 1971.
Killed to ground, 1972-73.

E. ovata
Raised from seeds from Tasmania, 1963; planted May 1964.
Killed to ground several times. Two plants still alive.

Species killed during recent winters

E. amygdalina
Seeds from Tasmania. Planted 1965.

E. cinerea
Seeds from N.S.W., Australia. Planted 1970.

E. glaucescens
Seedlings received from Cornell University; raised from Australian seeds. Planted May 1969; grew 12-14 ft. tall by December 1970. Damaged by 1971-72 winter; killed in following winter.

E. johnstonii
Seeds from Canberra, Australia. Planted 1965.

E. pulverulenta
Seeds from Canberra, Australia. Planted 1970.

E. viminalis
Seedlings from mountains of Tasmania. Planted 1970.

Arboretum Spotlight

Chimonanthus praecox, Wintersweet

J. A. Witt

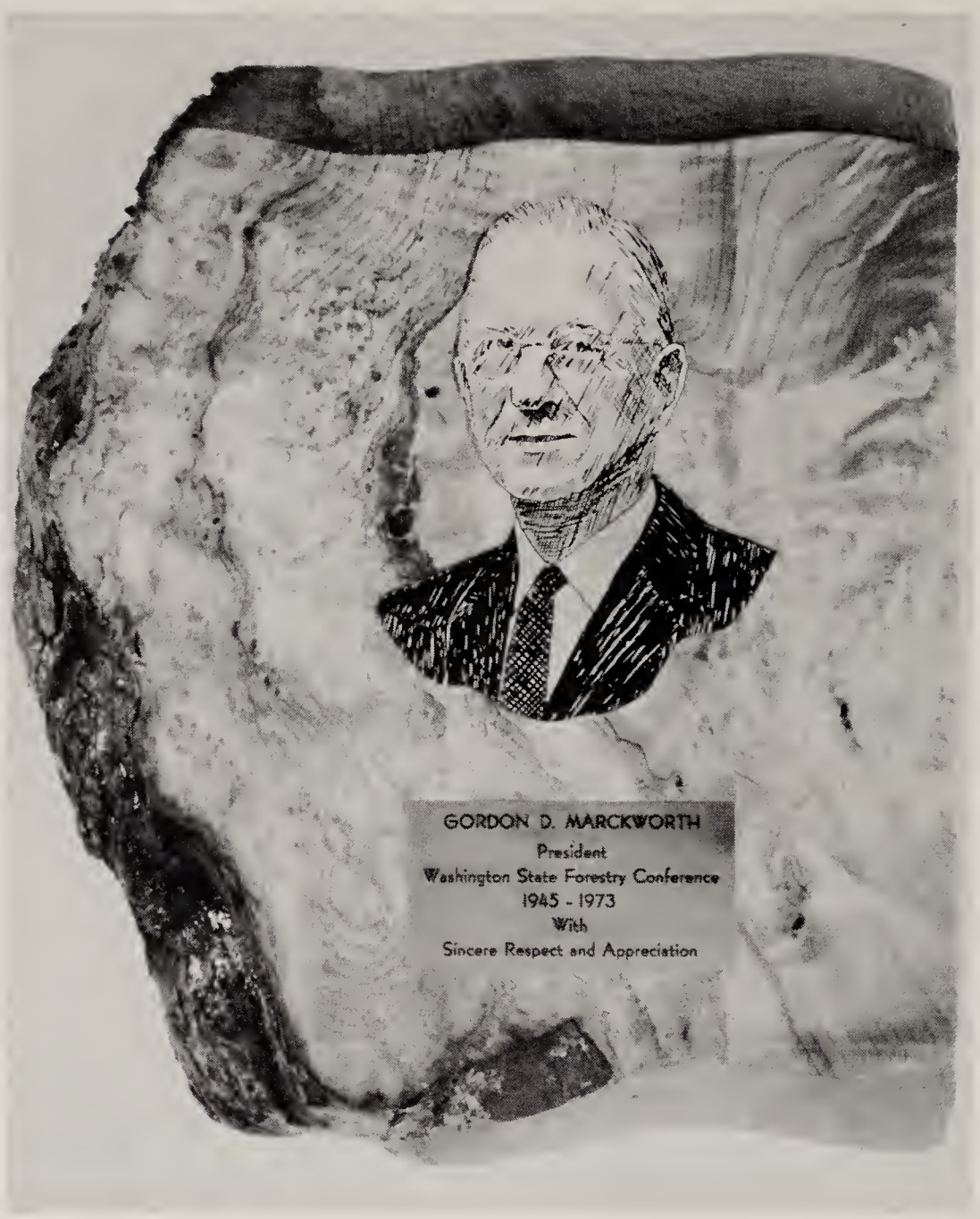
Have you ever noticed how many winter-flowering shrubs have a perfume that few spring blossoms can match? To name a few there are the Sarcococcas, *Viburnum farrieri* (once *V. fragrans*) and its hybrid *V.* X *bodnantense* 'Dawn', *Hamamelis mollis*, the Chinese witch hazel and that most fragrant of shrubs, *Chimonanthus praecox*.

It is probably well that wintersweet is so fragrant because it isn't especially beautiful in flower, and its habit may best be described as gawky. The Arboretum's largest plant is now about eight feet tall, which is near the maximum size expected. It has a stiff and upright branching pattern. In the summer the leaves are dark green, up to five inches long and rough to the touch, much like a cat's tongue. After the leaves drop in the autumn small rounded flower buds are noticeable along the bare branches and in December the first flowers open. These are carried in opposite pairs along the twigs, are about an inch wide and consist of an outer whorl of waxen textured pale yellow petals with an inner whorl of smaller purple to maroon petals. The flowering season extends over several months unless the weather is unusually warm (or severely cold in which case the buds may freeze). It seems shy in setting seeds in our climate but sometimes does. The fruit is not unlike a dried pear, greenish gray and hollow with numerous seeds inside, about 2 inches long and an inch in diameter.

A cultivar in some Seattle gardens is more attractive in flower than the common form. This is *Chimonanthus praecox* var. *grandiflorus* which has flowers nearly pure yellow and without the maroon inner petals. It is slightly less fragrant than the type to my nose but makes up for this lack in the beauty of its blossoms.

Wintersweet may never become a shrub for every-man's garden because it is difficult to propagate. We consider ourselves fortunate to get a fourth of the cuttings to strike when we attempt to increase it that way, and seeds aren't that plentiful.

If you want a treat for your nose visit the Winter Garden soon—a warm day is best—and smell out the wintersweet.



DEAN MARCKWORTH HONORED

*The annual meeting of the Washington State Forestry Conference held in Seattle in November, 1973 honored Dean Emeritus Gordon Marckworth of the School of Forest Resources at the University of Washington by dedicating the meeting to him and by presenting him with a myrtlewood plaque with his photographic likeness etched in copper. A brass plate identifies his years of service to that organization. Dean Marckworth, now Editor Emeritus of our BULLETIN, is well-known to our members for his efforts in that capacity and for his great interest in the Arboretum. We congratulate him on being the recipient of another recognition of his services to his profession. The presentation text follows:

> Gordon D. Marckworth has served this Conference as its President since 1945. During this time he has given unselfishly of his time and energy to the advancement of the aims of the Conference and the enhancement of good forestry in our State. He has been a leader among his peers.
>
> Therefore, be it resolved that the Washington State Forestry Conference thank Gordon Marckworth for his leadership and far-sighted guidance during his presidency;
>
> Be it further resolved that this Fifty-second Washington State Forestry Conference be dedicated to Gordon D. Marckworth.

*Editor's Note

SOME OF OUR FAVORITES
Won't You Send Us Yours?

Cornus nuttallii*

The classroom is filled with the woodsy fragrance of freshly cut greenery. Eager youngsters study the flat, blunt needles of a graceful branch of Western hemlock (*Tsuga heterophylla*); they smell the sprays of lacy foliage of the Western red cedar (*Thuja plicata*) as they crush them in their hands; they laugh as they find a cluster of seeds or 'helicopters' hanging from the bigleaf maple (*Acer macrophyllum*). Do the children have a favorite native tree? Perhaps it is the Pacific dogwood (*Cornus nuttallii*), a tree that delights them at each season of the year, spring, summer, fall and winter.

In spring our western dogwood is like a new snowdrift, the leafless branches gleaming with showy white blooms, two and one half to five inches in diameter, four to six petal-like bracts surrounding a flat cluster of tiny greenish flowers. Later the delicate foliage unfolds and then the bracts begin to fade and fall. The tree, in summer, is clothed with leaves three to five inches long, glossy dark green above, grayish green below, characterized by dogwood veins', curving parallel to the leaf edge. How delighted the children are to discover that their favorite not only makes a brilliant display in April, but often blossoms again, almost as freely, in August and September. In early fall the central clusters of flowers turn into compact groups of bright orange-red seed bearing fruits. Soon the dogwood leaves take on beautiful hues of red and gold and russet in a final burst of color, before the stormy winds of October tear them from the branches. In winter, this deciduous tree stands naked and the beauty of its symmetrical branching pattern is seen, each slender, upturned twig tipped by a greenish button-like bud.

Children are naturally curious. How did the dogwood get its name? One little boy had a quick answer, ''Because is has too much bark!'' Skewers or dags once were made from its wood, and it has been suggested that the name Dagwood was popularized as Dogwood. David Douglas was the first botanist to observe *Cornus nuttallii* as he explored the forested wilderness of the Pacific Northwest, in the early 1800s, but he assumed that it was the eastern dogwood. Thomas Nuttall, a botanist, and Dr. John K. Townsend, an ornithologist, recognized the tree as a new species in 1834 and Nuttall's friend, John James Audubon, later named it.

Wherever the climate is equable and prevalent southwesterly winds from the Pacific Ocean bring moisture for eight or nine months of the year, the western dogwood thrives in woodlands, up to an elevation of about 1500 feet. Perhaps on their way to school, our children pass a dogwood growing in a thicket of other trees and shrubs, where its trunk and roots are shaded from direct sunlight. Perhaps, on a guided tour in the Arboretum they notice a drift of white blossoms high up against a background of dark and sombre conifers. Many of these youngsters recognize the tree and know it as a favorite friend.

DORIS L. TAGGART

*See ARBORETUM BULLETIN, Vol. XXXV, No. 1, Spring, 1972, pp. 16-17.

HOLIDAY *(continued from p. 13)*

and others were very noticeable with their rose or peach colored, pendulous trumpets.

The scarlet flowers of the Chilean fire bush *Embothrium coccineum*, were just opening in the woodland, while out in the open in the extensive heather garden we saw the rosy-purple flowers of *Erica australis*, native of Spain and Portugal, the golden *Genista hispanica* from the same region, and ubiquitous *Potentilla fruticosa*, found wild all over the northern hemisphere and a most useful small shrub in its many forms. Like Wisley, these Gardens at Windsor offer a rich and varied selection of carefully maintained plantings for the enjoyment of their numerous visitors. Long may they continue to flourish!

UNIT CONVERSATIONS

The Arboretum Foundation Unit Council offers a fabulous slide program to its members. All one need do is to call the Foundation office at 325-4510 and make arrangements for a time to borrow one of these informative programs. Two projectors are available to loan along with the slides and a written commentary on each colored slide. The programs available upon request are:

1. Native Trees and Shrubs on the Native Walk
2. Early Winter Blooming Plants
3. Late Winter Blooming Plants
4. Minature Bulbs
5. Heathers
6. Cyclamen
7. Rhododendrons
8. Leaves
9. Savory Herbs
10. Let the Good Bugs Work For You

Also available from the Arboretum Office with a reservation at 543-8800 is "The Arboretum Through The Year." Why doesn't your unit schedule a meeting around one of these interesting planned programs done by experts?

An enthusiastic plant sale committee is at work on the spring sale to be held May 2-3 at the Arboretum. Thirty-three different departments are making plans to serve our customers as effectively and efficiently as possible.

One new department this year called "Edibles" will feature items for the "Victory" garden. Mary Jo Wise, chairman, plans to have some unusual vegetable plants as well as favorite fruit trees and berry plants. In the Few-of-a-Kind Shop will be found items for the collector as well as a great variety of summer bulbs by the bulb lady, Jeanne Gardiner.

The Rhododendron Department will include some new hybrids, some prize winners and rare and unusual species—thanks to Marilyn Kolesar, Sally Sue Coleman and the Rhododendron Study Group who have all been ferreting out from far and near the best available rhododendrons.

Other departments will feature azaleas, garden books, bonsai materials, ferns, fuchsias, geraniums, rockery and ground cover plants, heathers, herbs, indoor plants, natives, perennials, trees, shrubs and vines and material for a neglector's corner. Shuttle buses will operate as usual. For your convenience a pre-order appears on page 28.

Again the Plant Sale will have a Children's Corner and a Snack Bar so that plant sale shoppers can make it a family-fun time.

"SEE YOU AT THE PLANT SALE!"

IT'S TIME AGAIN!

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Book Reviews

SEASHORE LIFE OF PUGET SOUND, THE STRAIT OF GEORGIA, AND THE SAN JUAN ARCHIPELAGO, by Eugene N. Kosloff. University of Washington Press, Seattle and London, 1973. Pp VIII + s82; 223 figures (photographs and line drawings); 28 plates with a total of 68 color photographs. $15.00 cloth; $6.95 paper.

It is not really stretching things too far when one points out that the State of Washington, with its long and irregular coastline, offers us plenty of natural marine gardens in the form of intertidal zones which teem with plant and animal life. A discussion in our ARBORETUM BULLETIN of books dealing with such colorful gardens is certainly in order! Professor Kozloff, who until very recently was resident associate director of the University of Washington's Friday Harbor Laboratories and can speak on the basis of many years of personal experience, has done all of us a great service by zeroing in on the invertebrate animals and seaweeds of these fascinating intertidal zones in this attractive and immensely useful new book, which in all probability will soon be considered a "must" by beachcombers and boaters alike. Aided by numerous beautiful illustrations, Professor Kozloff shows us with great expertise, clarity, accuracy, skill and enthusiasm (and yet with commendable restraint) how we can find out what organism we have, in a given case, before us. Although his book is primarily aimed at the non-scientist, he wisely gives us the latin names of the organisms; in a nice and painless way, we also gain an insight into the morphological structure and the anatomy of the various organisms, and into their taxonomic relationships. Interested readers (and who could fail to become interested, in this case?) can use all this as an excellent springboard that in time will lead them to a deeper understanding of ecological relationships, physiological performance, and evolution. This is not to say that the book is deficient in bringing out ecological aspects; it gives interesting ecological facts and hints aplenty, and the organization of the book according to the habitat occupied by the organisms (floating docks and piling, rocky shores, sandy beaches and quiet bays) further indicates its ecological orientation. Higher plants such as *Salicornia, Cuscuta* and Distichlis are mentioned in connection with salt marshes.

This reviewer, known to be a hairsplitter, has found practically no spelling errors or nomenclatorial mistakes in the book. It is true that *Lithothamnium*, rather than *Lithothamnion*, is nowadays considered to be the correct name for a certain coralline alga, but this is based on a *very* recent nomenclatorial decision; moreover, we doubt that the interested amateur will lose much sleep over this matter! The ten-page index of the book is very good. Other useful features are the glossary of more than five pages, and the two pages of suggestions for further reading.

Summing it up: we give this book our most enthusiastic recommendation, without any reservation.

B. J. D. MEEUSE
Professor of Botany
University of Washington

P. TOMPKINS & C. BIRD. "THE SECRET LIFE OF PLANTS". Harper and Row, Publishers; New York, Evanston, San Francisco & London, 1973. XIV 402 pp. $8.95.

It is somewhat surprising to find that Harper and Row, usually considered to be reputable publishers of scientific works, have moved into the comic book genre; yet, no other conclusion is open to the astonished reader of this *magnum opus* by Tompkins & Bird. Not even thirty-five years of correcting students' papers have adequately prepared me for such picturesque statements as the one on p. X that "small hollow chambers in which a *ball* of starch can *rattle* indicate to the root tips the direction of the pull of gravity." Well, well, well! If I may, for a moment (and for a moment *only*), borrow the authors' way of reasoning: there *must* be some truth in the old Dutch saying that a cow can catch a rabbit by imitating the sound of a growing cabbage! —As a person interested in the pollination of flowers, I was also fascinated by the statement (p. XI) that "plants seem to know which ants will steal their nectar, closing when these ants are about, opening only when there is enough dew on the stems to keep the ants from climbing." At first sight, it seems that such a situation must create quite a dilemma for the poor plants awaiting their pollinators, for exactly at those times when winged insects are active, on warm, bright and sunshiny days, the flowers must remain scrupulously closed because those naughty ants are around also, and dew is absent; and when the flowers can open up safely, early in the morning when there *is* dew—alas and alack, not a single pollinator may be in sight! But of course (as I realized after only a few seconds of contemplation) there is one surefire way out. After all, *who needs insects*? The smart, independent flower *simply stays closed all the time and pollinates itself.* Eureka—who could deny that this sort of reasoning provides us with a superb explanation of the phenomenon of cleistogamy? It must have been modesty, pure and simple, which has prevented Tompkins & Bird from taking credit here.—For lovers of off-color humor, there are (on p. 105 and 106) some juicy and very detailed but, unfortunately, incorrect comparisons of stamens and pistil with human sexual organs, plus (on p. 108) some nice innuendoes concerning the (alleged) voyeuristic tendencies of the great Swede Linnaeus.

For students of history and evolution, there is (on p. 224) the amazing tale of the Hunzas, an ancient people in a corner of Afghanistan, claiming descent directly from the soldiers of Alexander the Great. Eating only "natural foods," they are said not only to walk 120 miles at a stretch in the roughest mountain country in the world, or cut two holes in a wintry lake and swim from one to the other under the ice for the fun of it, but with the exception of an occasional eye inflammation due to badly ventilated fires in their huts, they are wholly free

of disease too. McCarrison, a British gentleman quoted approvingly by the authors, also found the Hunzas' health to be matched by their superior intelligence, wit and urbanity; *though they were numerically few* and their neighbors warlike, they were rarely attacked—because they always won. This one is still a head-scratcher for me. For one thing, attempting to swim under the ice from one hole to the other does not jibe with my definition of being "intelligent, urbane and witty." Furthermore, if these people are indeed healthy, disease-free, vigorous, long-lived, and so smart that they easily outwit their enemies (and remember, as the descendants of Alexander's warriors they must have been invincible to begin with!) how come we don't see millions of them? A clue to the mystery can perhaps be found in the statement (on p. 278) that the Hanoverian Baron Albrecht von Herzeele discovered in 1873 that plants seem to be able to *transmute*, in alchemical fashion, phosphorus into sulfur, calcium into phosphorus, magnesium into calcium, carbonic acid into magnesium, and nitrogen into potassium. This nobleman would be an interesting person indeed to have around in our present energy-crisis! But alas, my unerring intuition tells me that "von Herzeele" is nothing but a pseudonym for the illustrious Baron von Münchausen, whose exploits easily dwarf those of Paul Bunyan. Now that this point has been "firmly established," we can extrapolate from it (again, in true Tompkins & Bird style!) and state point-blank that our German friend and the authors who quote him so approvingly must have been a strong supporter of the idea *"warum einfach, wenn's auch kompliziert geht?"* (or, in plain English: "Why keep things simple when you can make them complicated"?).

Indeed, this Münchausian approach of "muddying the waters" is the pervasive theme of the Tompkins & Bird book. To illustrate this: plants are said to be able to read our intentions, and it would seem that the sensitive plant, *Mimosa pudica,* would be a magnificent test-object here, since it does not require any special equipment: approached with a burning match, the leaflets should fold *immediately*, before the establishment of any actual contact (this is *not* what happens, by the way). But how pedestrian can one get? Is not it much more glorious, awe-inspiring and world-shaking to use *lie-detectors* on plants; to let cactuses count up to twenty, or to ask them to put two and two together with complicated (and expensive) electronic equipment? Obviously subscribing to this grandiose and sweeping approach, the authors must have considered it downright picayunish to worry about the difference between variety species, genus and family (p. 126 and other places), to spell latin names correctly (p. XIII, *Arbrus precatorius* instead of *Abrus precatorius*; p. 42, *Acetabularia cremulata* instead of *A. crenulata*), or to quote names ("H. A. Lorentzen, a mathematician," p. 102) and historical dates properly (there *was* no International Botanical Congress in Montreal in 1954). Who cares; is not this whole business a huge joke anyway? The answer is: *not quite.* The inescapable fact is that the authors have helped to create a climate in which emotionalism, nebulous claims, charlatanism and downright deceit can flourish. Such a climate prevailed in Russia in the days when Trofim Lysenko held sway as a biological politician (small wonder Tompkins and Bird have so many Russian claims to quote from!). Ultimately, this led to a situation in which good and honest scientists such as Vavilov (a man who has served Russia, and humanity, exceedingly well) could literally be hounded to death. Very funny indeed! Even in Western countries, we must be constantly on guard against such perversion of science. The authors can, of course, laugh about this all the way to the bank—but before a jury of honest men, they stand condemned.

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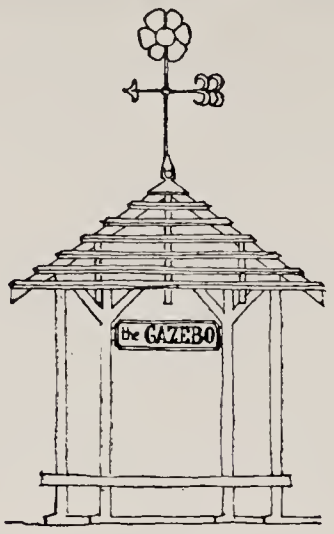

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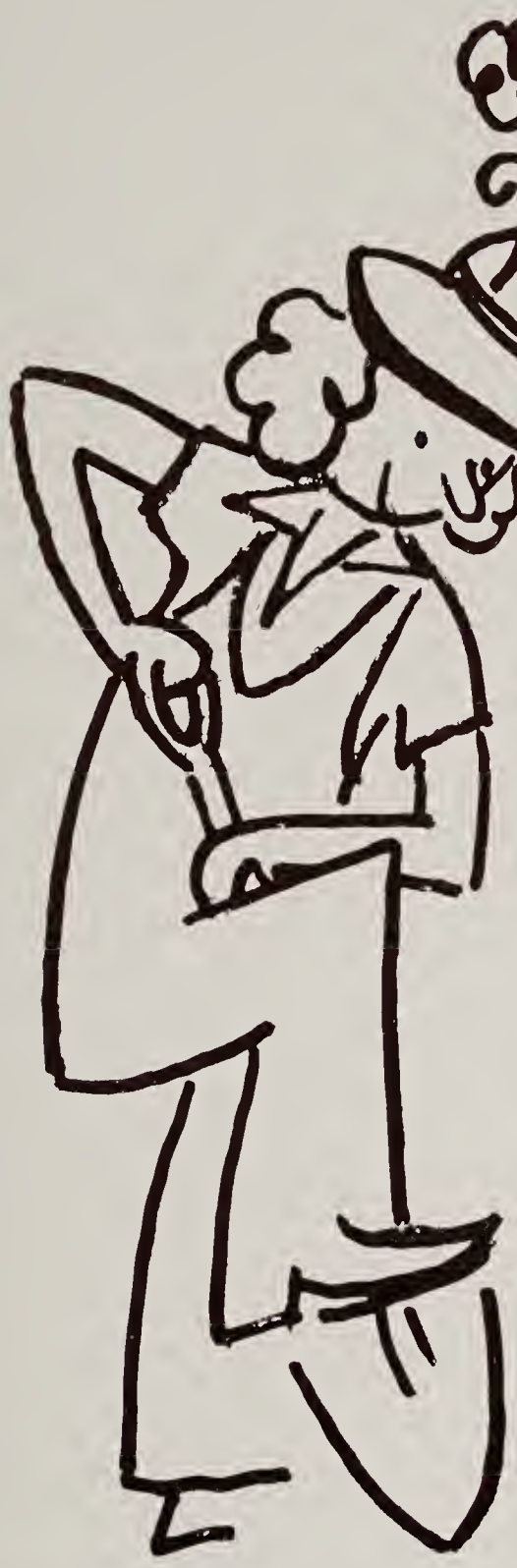

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